ciliata et glandulosa; flores radii circiter 25, ligulis 3 mm. longis, 0·8 mm. latis, aut albis aut caeruleis; receptaculum 1·5–2 mm. latum, 1·5 mm. altum, conicum; achaenia 1·9–2·1 mm. longa, 1·1–1·4 mm. lata, oblonga-obovata, compressa; fulva; corpore anguste-elliptico, ab latis in acuta segmenta inaequaliter pinnatisectis alis acute secto; pappus simplicibus setis tam longis aut paulo longioribus quam incisura intra alas.

Much branched erect or ascending perennials, up to 36 cm. high, with a microscopically glandular indumentum. *Leaves* numerous, cauline, cuneate; those towards the base up to 3·5 cm. long, with 7 acute teeth, and tapering into the slender petiole. Upper leaves smaller, and finally sessile. *Peduncles* usually slender, with 1 or 2 filiform leaves. *Inflorescences* very numerous, up to 1·5 cm. diameter across the expanded rays. *Involucral bracts* 18–22, 4 mm. long, 0·6–0·8 mm. broad, linear, acuminate, microscopically torn-ciliate and glandular. *Ray florets* about 25, the rays 3 mm. long, 0·8 mm. broad, white or blue. *Receptacle* 1·5–2 mm. broad, 1·5 mm. high, conical. *Fruits* 1·9–2·1 mm. long, 1·1–1·4 mm. broad, oblong to obovate, flat, light brown; the body narrow-elliptical, sharply demarcated from the broad wings which are very irregularly dissected into acute lobes. Pappus of simple bristles equal to, or slightly exceeding, the notch between the wings.

Range: Inland districts of eastern Victoria, along river banks.

Specimens examined: Victoria, Wangrabelle, Genoa River, "abundant amongst granitic rocks, in crevices, about 400 ft.", 3.1948, N. Wakefield No. 2222 (MEL); Genoa River gorge, 1.1947, N. A. Wakefield No. 3298 (MEL); Genoa River, near Maramingo Hill, "in crevices and amongst granitic rocks, below flood level", 1.1.1954, N. A. Wakefield, No. 4803 (MEL); Gelantipy, Snowy River, 22.1.1953, L. Hodge No. 4718 (MEL); Snowy River, east of Butcher's Ridge, "in crevices and amongst porphyry rocks, below flood level", 22.1.1954, N. A. Wakefield No. 4804 (MEL); gorge track of the Upper Snowy River near Deddick, 27.1.1948, J. M. Béchervais (MEL); Betebolong, Snowy River, "growing in crevices of granite rocks in the river bed", 12.1945, N. A. Wakefield, No. 3299 (MEL).

This species is confined to eastern Victoria where "it extends for at least 20 or 30 miles along the Snowy and Genoa Rivers, and is never far away from the waterside rocks".* Mr. Leo Hodge has established some plants in his garden in East Gippsland, one of which "produced a dense mass of stems, to form a tuft about 18 inches across".* These were all transplanted by Mr. Hodge "from the sand high above the average rise of the Snowy River where *Acacia* has grown tall. In such places it is quite spindly, but higher up on the cliffs where the soil is better and there is less shade, it is quite bushy, though not so much as those of my garden which are more vigorous and have more flowers".

Vegetatively *B. riparia* strongly resembles certain populations of both *B. aculeata* (Labill.) Less. and *B. marginata* Benth., a resemblance which is also apparent in the fruits. A notable feature of the fruits is the variation in the dissection of the wing, no two fruits, even of the same capitulum, being identical in this respect. All, however, are deeply and irregularly cleft into acute lobes. Originally regarded as an aberrant form of one of these related species, the enthusiasm and interest of the two collectors mentioned have produced sufficient material to show that its particular characters are constant throughout its range, and to justify specific status.

Subgenus METABRACHYCOME G. L. Davis.

Superspecies IBERIDIFOLIA.

BRACHYCOME EYRENSIS, sp. nov.

(Text-figures 18–20.)

Holotype: Figure-of-Eight Island, Recherche Archipelago, Western Australia, 7.11.1950, J. H. Willis (MEL). *Paratypes*: Three. *Loc. cit.* (MEL.)

Herba in speciem annua, 3·7–16 cm. alta, a basi in 2–7 primos caules ramosa, in ultima parti mic. glandulosa; folia radicalia ad 2 cm. longa, 4 mm. lata, petiolis et 3–5 altis acutis dentibus plerumque adsunt; folia caulina, inferiora ad 2 cm. longa, petiolis

* Personal communication of Mr. N. A. Wakefield, of Noble Park, Victoria.

brevibus et 3–5 dentibus, superiora minora et plerumque integra, multa sunt; pedunculi graciles axillares et terminales, aut nudi aut uno parvo folioso phyllo; capitula ex magnitudine et ramorum numero 3–40; involucri phylla 9–10, exteriora 1·6–1·8 mm. longa, 1 mm. lata, oblonga, integra, glandulosa, in ultima parti teretia; flores radii 25–40, ligulis 1·5–2 mm. longis, 0·5 mm. latis; receptaculum 1 mm. latum, 0·5 mm. altum, compressum, vix punctum; achaenia 1 mm. longa, 0·5 mm. lata, cuneata, compressa, maturitate nigra, in media parti mic. canis tessellis et paucis crispis pilis interdum in ultima parti; pappus abest.

Apparently annual plants 3·7–16 cm. high, branching from the base into 2–7 primary stems; microscopically glandular distally. *Radical leaves* usually present, up to 2 cm. long, 4 mm. broad, petiolate, with 3–5 deep acute teeth. *Cauline leaves* numerous, the lower shortly petiolate, up to 2 cm. long, 3–5-toothed; the uppermost smaller and often entire. *Peduncles* slender, axillary, and terminal, naked or with a single small leaf-like bract. *Inflorescences* 3–40 according to size and degree of branching of the plant. *Involucral bracts* 9–10, the outer 1·6–1·8 mm. long, 1 mm. broad, oblong, entire, glandular, rounded distally. *Ray florets* 25–40, the rays 1·5–2 mm. long, 0·5 mm. broad, "white or pale bluish". *Receptacle* 1 mm. broad, 0·5 mm. high, flattened, hardly pitted. *Fruits* 1 mm. long, 0·5 mm. broad, cuneate, flat, black at maturity, with microscopic grey tessellations; a few curled hairs may be present distally, but a pappus is absent.

Range: South-eastern coastal belt of Western Australia in the Recherche-Israelite Bay area.

Specimens examined: Western Australia: Near Mt. Ragged, 1889, S. Brooke (MEL); between Mt. Ragged and Victoria Spring, near Israelite Bay, 1886, S. Brooke (MEL); Round Island, Recherche Archipelago, 18.11.1950, J. H. Willis (MEL); Figure-of-Eight Island, Recherche Archipelago, 17.11.1950, J. H. Willis (MEL).

According to Willis (1953) "abundant on many islands, from Figure-of-Eight to Goose (but not seen on the larger masses of Mondrain and Middle) is a noteworthy variant of *Brachycome pusilla*. This decumbent annual has rather foliose branches, broad strongly dissected leaves and short white or pale bluish rays".

Specimens collected by Mr. Willis are similar in habit and vegetative features to *B. exilis* Sond., but the fruits are closest to those of *B. bellidioides* Steetz. Their flattened nature and complete absence of pappus are, however, distinctive features which justify specific status.

The specific epithet was chosen at the suggestion of Mr. J. H. Willis, and refers to the fact that this species appears to be confined to the Eyre Region of Teakle (1937), which embraces the coastal sandheath between Albany and Israelite Bay.

New Locality Records.

Subgenus EUBRACHYCOME G. L. Davis.

Superspecies TENUISCAPA.

BRACHYCOME OBOVATA G. L. Davis, PROC. LINN. SOC. N.S.W., lxxiv (1949): 146.

New South Wales: Kosciusko, 7000 ft., swamp, 10.3.1953, E. Gauba (CP).

This species was previously recorded only from eastern Victoria.

BRACHYCOME STUARTII Benth., *Fl. Aust.*, iii (1866): 513.

New South Wales: Point Lookout, New England, 17.4.1937, K. Ingram (KI); Boyd River, Blue Mts., wet mossy places, 4.3.1954, E. Gauba (CP).

This species has now been recorded from as far west as Mudgee (Davis, 1949) and south to the Blue Mountains, where Dr. Gauba reports having seen it also in the Cudgegong Mountain District.

Superspecies LEPTOCARPA.

BRACHYCOME DEBILIS Sond., *Linnaea*, xxv (1852): 477.

New South Wales: Between Cumnock and Beldry, 15.10.1947, C. W. E. Moore no. 867 (C).

Hitherto recorded in New South Wales only from western and south-western districts.

Superspecies BASALTICA.

BRACHYCOME NOVA-ANGLICA G. L. Davis, PROC LINN. SOC. N.S.W., lxxiii (1948): 178.

New South Wales: Between Grafton and Glen Innes, 25.4.1912, J. B. Cleland (AD).

BRACHYCOME MULTIFIDA DC., *Prod.* V (1836): 302, Var. DILATATA Benth., *Fl. Aust.*, iii (1866): 520.

New South Wales: Smoky Cape, Macleay River, 2.9.1941, K. Ingram (KI); South West Rocks, 12.1946, K. Ingram (KI).

Previously not recorded north of the Manning River.

Superspecies ACULEATA.

BRACHYCOME MUELLEROIDES G. L. Davis, PROC. LINN. SOC. N.S.W., lxxiii (1948): 194.

New South Wales: Bulgandry Reserve, white rays, plentiful around lagoons, rooted in mud or in water with *Cotula* and *Centipeda* spp., 14.10.1949, E. J. McBarron (NSW. No. 10168); Fagan's Reserve, 3 miles north of Walbundrie, white rays, plentiful on margins of lagoons, in mud or water, mixed with *Calotis* sp., 14.10.1949, E. J. McBarron (NSW. No. 10167).

These records link up the two original localities cited, Wagga and Nathalia, and the ecological notes confirm the earlier suggestion (Davis, 1948) that this species occupies a wet habitat among herbage. Until now, the colour of the ray florets has not been known.

Superspecies TESQUORUM.

BRACHYCOME BLACKII G. L. Davis, PROC. LINN. SOC. N.S.W., lxxiii (1948): 207.

Central Australia: Mt. Ultim, 1.9.1930, J. B. Cleland (JBC); Mt. Allen, Summit, 9.8.1936, J. B. Cleland (JBC).

Subgenus METABRACHYCOME G. L. Davis.

Superspecies IBERIDIFOLIA.

BRACHYCOME EXILIS Sond., *Linnaea*, xxv (1852): 449.

South Australia: Greenby Island, North Island, 20 miles from Eyre Peninsula, 12.1947, Adelaide Bush Walkers (JBC).

Superspecies TRACHYCARPA.

BRACHYCOME TRACHYCARPA F. Muell., *Linnaea*, xxv (1852): 339.

Western Australia: Halfway between Mt. Ragged and Victoria Springs, 1886, S. Brooke (MEL).

This is the first and only record of this species from Western Australia.

Superspecies SILPHIOSPERMA.

BRACHYCOME PERPUSILLA (Steetz) Benth. var. TENELLA (Turcz.) G. L. Davis, PROC. LINN. SOC. N.S.W., lxxiii (1948): 231.

New South Wales: Corner Reserve, 6 miles from Henty, fairly common in barer grassland and red sandy loam, 6.9.1947, E. J. McBarron (NSW. No. 10173); Bulgandry Reserve, fairly common but little flowering in grassland, red sandy loam, 2.10.1949, E. J. McBarron (NSW. No. 10166); Walbundrie, common in damp depressions in open paddocks, 17.9.1948, E. J. McBarron (NSW. No. 2014); Jindera Gap, common in gravel soil 2.10.1949, E. J. McBarron (NSW. No. 10165).

These specimens extend the range of this species into southern New South Wales where it appears to be relatively common in grassland.

Acknowledgements.

My thanks are extended to the Directors of State Herbaria and private collectors mentioned in the text, for lending the specimens on which this paper is based.

In particular, I would like to acknowledge the assistance of Mr. J. H. Willis, of the National Herbarium, Melbourne, and Mr. N. A. Wakefield, of Noble Park, Victoria, with both of whom I have been in constant communication in connection with the new species collected by them.

I am also indebted to Miss Greta Baddams, formerly of the University of New England, for writing the Latin diagnoses of the new species.

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THE INFLUENCE OF THE PHYSICAL PROPERTIES OF A WATER CONTAINER SURFACE UPON ITS SELECTION BY THE GRAVID FEMALES OF *AËDES SCUTELLARIS SCUTELLARIS* (WALKER) FOR OVIPOSITION (DIPTERA, CULICIDAE).

By A. K. O'Gower.*

(One Text-figure.)

[Read 24th November, 1954.]

Synopsis.

Aëdes scutellaris (Walker) belongs to the subgenus *Stegomyia*, the members of which predominantly breed in tree holes and other similar water containers, thus the selection of an oviposition site by the members of this group was thought to be guided more by visual and tactile stimuli than by olfactory stimuli.

The physical properties of the water container surface were found to be important in determining the attractiveness of an oviposition site due to the visual and tactile stimulation of its surface. These physical properties were the texture of the surface, the illuminance reflected from it, and the amount of moisture or water present within the container.

When these properties were studied separately a rough textured surface was preferred to a smooth one, a surface of low reflectance was preferred to one of high reflectance, and a free water surface was preferred to a moist, porous surface.

When these physical properties of the water container surface were studied jointly, it appeared that the gravid mosquitoes were first attracted to an oviposition site by its reflected illuminance, but the decision whether to oviposit, or what proportion of the total egg batch was to be deposited, was governed by the texture of the surface. A moist porous surface of rough texture and low reflected illuminance was so attractive as an oviposition site that all other single preferences for the various surfaces did not occur; it was therefore concluded that such a surface, being similar to that of the preferred oviposition sites found in nature, probably did determine the attractiveness of an oviposition site.

Introduction.

The selection of an oviposition site by gravid female mosquitoes has been found to be influenced by (1) such chemical and physical properties of the water as salinity (Woodhill, 1941), temperature (Hecht, 1930; Weyer and Hundertmark, 1941), organic pollution (Buxton and Hopkins, 1927; Manefield, 1951); (2) the type and amount of vegetation present in the water (Russell and Rao, 1942; Hess and Hall, 1945; Rozeboom and Hess, 1944); (3) the illumination of the breeding site (Muirhead-Thomson, 1942); and the physical properties of the surface of the water container, such as the illuminance reflected from its surface (Jobling, 1935; Kennedy, 1942), the texture of the surface and the water vapour pressure gradient.

In the majority of these oviposition investigations, gravid mosquitoes of different species were offered choices between containers of water which varied in some property which the author considered as important in limiting the larval distribution of the species. Although much information has been gained in this manner about species which breed in ground water, little has been learnt of the environmental factors which influence the selection of an oviposition site by those species which breed in container habitats.

As the larvae of the *scutellaris* group of mosquitoes are always found in small accumulations of water, such as occur in tree holes, coconut shells, empty cans and other similar containers (Farner and Bohart, 1945), and as Penn (1947) failed to show any delimitation of the larval habitat of *Aëdes scutellaris* due to organic pollution, salinity, water flow, water temperature, pH, specific gravity or vegetation, it was thought that the selection of an oviposition site by the gravid females of this species

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was probably influenced by the properties of the water container surface, rather than by any properties of the water itself.

Thus the physical properties of the water container surface which were studied in this investigation are the illuminance reflected from the surface, either high, medium or low; the texture of the surface, either rough or smooth; and the gradient of the water vapour pressure from either a free water surface or a moist porous surface, such as is obtainable by wetting a filter paper.

Experimental Technique and Results.

Because the adults of *A. scutellaris* readily feed, copulate and oviposit within confined spaces, and as the larvae of this species are always found in small accumulations of water, it was thought that the behaviour pattern involved in the selection of an oviposition site by the gravid females of *A. scutellaris* in nature was similar to that observed in colonies of this species in 10 inch × 10 inch × 12 inch cages, which contained either filter papers folded into cones or Petri dishes as the water containers. These cages were kept in a constant temperature and humidity room operating at 27° ± 2°C., with a *saturation deficiency* of 10 ± 2 mm. of mercury. Each cage contained approximately fifty adults of each sex, either two or three water containers whose relative positions were altered daily, and some raisins for food. Human blood meals were offered thrice weekly, and deaths were replaced by adults from a stock colony.

Table 1.

Percentage Reflectances of Filter Papers Used as Water Containers.

Filter Papers.	Wavelength in Millimicrons.						
	400	450	500	550	600	650	700
Black Smooth Dyed ..	4	4	3	3	4	4	5
Black Rough Dyed ..	4	4	3	3	3	4	6
Black Smooth	7	7	6	6	6	6	7
Grey Smooth	28	28	27	26	25	26	31
Grey Rough	22	23	22	21	21	23	26
White Smooth	84	86	87	87	87	88	90
White Rough	78	82	82	82	82	82	83

When studying the texture and reflected illuminance of the water container surface the containers were made by folding filter papers of 11 cm. diameter into cones and placing them in beakers. Water was added to these until the beakers were full and the water levels were half the height of the cones.

When studying the preference for either a free water surface or a moist, porous surface, the containers were Petri dishes of 9 cm. diameter with paper taped around the sides whose reflectance matched that of the dishes. Into one dish water was poured and beneath it was placed a filter paper of the required reflectance, and in the other dish was a water soaked pad of cotton wool with a filter paper of the required texture and reflectance on top of it.

The filter papers* used to form the water containers had surfaces which were (i) white and smooth; (ii) white and rough; (iii) grey and smooth; (iv) grey and rough; and (v) black and smooth. White smooth papers and grey rough papers were dyed black with a "Tintex Dye" as required.

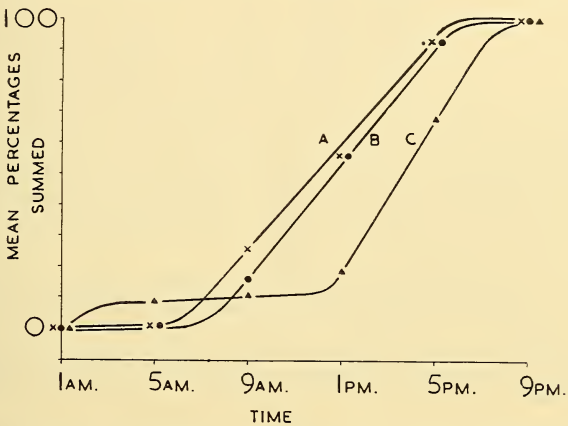
The percentage reflectances of these filter papers used as water containers were measured over the visual range of the spectrum by a General Electric spectrophoto-

* (i) Whatman No. 5; (ii) Postlip Mills No. 633C; (iii) Allnutt and Sons No. B.1; (iv) Allnutt and Sons No. D.3; (v) Schleicher and Schüll No. 551.

meter* using magnesium carbonate as the surface of reference (Table 1). These reflectances were expressed as ratios (column 3 of Tables 2, 3, 4, 5 and 6) by assigning a value of 100 to the paper of highest reflectance and expressing all the reflectances of the other papers used in these experiments as ratios of it.

The times of oviposition upon black, grey and white filter paper water containers were individually determined by counting the numbers of eggs deposited upon each at four-hourly intervals throughout four consecutive days.

All the eggs deposited in water containers of low reflectances in a twenty-four hour period were laid in daylight, with the majority being deposited between 9 a.m. and 5 p.m.; however, the majority of the eggs deposited in a water container of high reflectance were laid at dusk and to a lesser extent at dawn (Figure 1).



Text-fig. 1.—Time of oviposition by *A. scutellaris*. A, upon a black, water container surface. B, upon a grey, water container surface. C, upon a white, water container surface.

The daily rate of oviposition and the mean total number of eggs deposited by single female mosquitoes was individually determined for twenty females after each had fed once. It was found that the eggs developed from a single blood meal were deposited either *in toto*, over a period of two or three consecutive days, or over a period of four days. The mean total number of eggs deposited by each female mosquito was 62.

1. *The effect of the illuminance reflected from the surface of a water container upon its attractiveness as an oviposition site.*

The gravid mosquitoes were first given a choice between two water containers whose surfaces were either black or grey, grey or white, and black or white; then the choice was between three water containers whose surfaces were black, grey and white.

From Table 2 it can be seen that a close correlation exists between the reflected illuminance of a water container surface (column 3 of Tables 2, 3, 4, 5 and 6) and its attractiveness as an oviposition site (column 6 of the same tables), provided the textures of the surfaces are smooth (experiments 1 to 4 of Table 2). An example is experiment 4, in which the percentage ratio of reflectances of the filter papers was 7:30:100, whilst the percentage ratio of eggs deposited upon each paper was 59:34:4.

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* These measurements were made by the Division of Physics, National Standards Laboratory, C.S.I.R.O., University Grounds, Sydney, and the author wishes to thank Dr. R. G. Giovanelli for this service.

TABLE 2.

The Relationship between the Reflectance of the Water Container Surface and Its Attractiveness as an Oviposition Site to the Females of A. scutellaris.

Experiment Number.	Number of Replicates.	Water Container Surface.	Reflected Illuminance.	Number of Eggs Deposited.	Mean Percentage of Eggs Deposited.
1	7	Black Smooth	7	5,593	70
		Grey Smooth	30	2,384	30
2	7	Grey Smooth	30	3,783	91
		White Smooth	100	413	9
3	7	Black Smooth	7	8,364	96
		White Smooth	100	271	4
4	11	Black Smooth	7	5,653	59
		Grey Smooth	30	3,504	37
		White Smooth	100	391	4

2. *The effect of the texture of a water container surface upon its attractiveness as an oviposition site.*

The gravid mosquitoes were given a choice, both in a normal night and day cycle and in constant darkness, between two water containers whose surfaces were black and smooth, and black and rough. Alternatively the mosquitoes were offered as an oviposition site a smooth, black, filter paper water container, from whose centre radiated regularly spaced, black, cotton threads.

When the reflected illuminances of the water container surfaces were similar, the texture of the surfaces determined their attractiveness (experiments 5 and 6 of Table 3). Similarly the distribution of the eggs deposited upon a water container surface was determined by the texture of that surface, as the majority of the deposited eggs were laid along the black, radiating, cotton threads, whilst the remainder were laid on the black, smooth paper between the threads (experiment 7 of Table 3).

TABLE 3.

The Relationship between the Texture of the Water Container Surface and Its Attractiveness as an Oviposition Site to the Females of A. scutellaris.

Experiment Number.	Number of Replicates.	Water Container Surface.	Reflected Illuminance.	Number of Eggs Deposited.	Mean Percentage of Eggs Deposited.
5*	11	Black Rough	3	14,663	60
		Black Smooth	3	9,750	40
6†	5	Black Rough	3	3,068	61
		Black Smooth	3	2,040	39
7	5	Black Smooth	3	1,494	40
		Black Threads	3	2,253	60

* In normal night and day cycle.
† In constant darkness.

3. *The effect of the amount of moisture present within a water container upon its attractiveness as an oviposition site.*

The gravid mosquitoes were offered a choice between two Petri dishes as the water containers for oviposition whose reflectances were similar; one dish contained water, the other had a moist porous surface.

The container with a free water surface was slightly but distinctly preferred to a moist, porous surface when both had equal reflected illuminances (experiment 8 of Table 4).